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CORR Insights®: Apical and Intermediate Anchors Without Fusion Improve Cobb Angle and Thoracic Kyphosis in Early-onset Scoliosis

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Where Are We Now?

Early-onset scoliosis is a challenging problem that can result in severe deformity, pulmonary insufficiency, and early death. In recent years, there has been great interest in improving the lives of the children affected. Journals are stocked with studies describing competing options that often have similar or identical indications. Derotational casting or bracing, single or dual growing rods, the VEPTR (Synthes Spine Co. West Chester, PA, USA), Shilla (Medtronic Spine, Memphis,

TN, USA), and anterior flexible tethers are some of the more widely-used options available. Casting and bracing certainly present the least chance of harm to the child and should be chosen for all but the most difficult-to-control curves. Although there is great interest in casting as a cure for infantile scoliosis, casting has also recently been demonstrated as a viable alternative to surgical procedures in delaying definitive fusion in young children [5]. Though occasional skin ulcers arise, growth occurs while spine flexibility is maintained. Growing rods and the VEPTR require regular open

procedures to keep pace with the growth of the child. This leads to multiple opportunities for deep infection. Because the devices are distraction-based, kyphosis is often an issue. The diminishing height gains seen with multiple lengthenings [8] or spontaneous spinal fusions [2] also are disturbing. Magec Rods (Ellipse Technologies, Irvine, CA, USA) offer the hope of fewer operations as the rods can be lengthened without an operative intervention. However, these rods only elongate 45 mm, so revisions to place new rods can be expected. Of course, revisions for anchor shifting and similar issues also remain. At present, the high cost of the Magec rods will likely guarantee a financial loss for any hospital. In the Shilla technique, three to four apical vertebrae are exposed and fused using pedicle screws, while proximal and distal screws that capture, but do not lock to the rod, are placed without subperiosteal exposure. Rods with sufficient length are inserted allowing for growth, which occurs as the end anchors slide over the rods without the need for additional procedures. Early

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published results [7] seem promising, but concerns about early spontaneous fusions and the challenges of placing secure pedicle screws in a young child have limited the procedure's acceptance. A similar growth strategy, the Luque trolley, has been largely abandoned because of early spontaneous fusions complicating growth [6].

Where Do We Need To Go?

In their modified growing rod technique, Enercan et al. [4] describe proximal and distal anchors similar to more standard growing rod techniques, but place extaperiosteal sliding intermediate anchors throughout the spine. The extra anchors allow for greater correction at the initial implantation, and also proved to hold the correction. In particular, problems with kyphosis were not observed in the current study. The most common complication was disassembly of the intermediate anchors, a problem that could be easily remedied by partnering with an implant company to design a screw especially for that purpose. It certainly seemed likely that the increased rigidity of the entire construct or possibly inadvertent damage to the facets while placing intermediate screws could have led to early fusions. Fortunately, this was not observed in the current study. The study did

demonstrate a decline in length gains after the fifth lengthening, consistent with the diminishing returns seen with more typical growing rods. This decline occurred despite planning lengthenings every 6 months, which has been demonstrated to result in improved length gains compared with less frequent lengthenings [1]. With a sharp decline in elongation after the fifth lengthening, and with lengthening typically done every 6 months, it certainly seems prudent to withhold any growing rod technique until a child is within 2.5 years of an acceptable thoracic length.

Therefore, we are faced with several difficult questions. How does a surgeon balance worsening deformity against early surgery? Is the final result better by allowing a child to grow and continue to progress their deformity or operate earlier and face more lengthening procedures with risks of infection or spontaneous fusion? How does a surgeon decide which of the various options (growing rods, anterior tethers, Shilla) is best for a given child when a surgical procedure is necessary? The problem with almost all of the studies in pediatric orthopaedics is that we are forced to study intermediate outcome variables. While curve magnitude at final fusion certainly is well worth reporting, what we are truly interested in is the physical and psychological function of the child as an

adult. Are frequent surgical manipulations causing future difficulties for these children, or will developmental impairments [3] from repeated anesthetics limit the usefulness of these procedures?

How Do We Get There?

The recent formation of various study groups provides hope that multicenter studies will be forthcoming on a variety of these techniques. Making information available, possibly online, regarding the demographics and outcomes of each individual child would be useful, as it may likely prove that one technique, for example Shilla, works well for children that have a shorter time until definitive fusion, while other techniques may be best in other situations. This information is difficult to discern in case series reports. Orthopedists should keep abreast of the anesthesia literature on the effects of repeated procedures on developmental issues in children. Lastly, every effort to obtain long-term followup on the functioning of children with early onset scoliosis as adults must be supported.

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